Computer Networks

Homework 3

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# Problem 1:

A signal is sampled two times each microsecond, into samples carrying 2 bits of information each. The communication channel has a bandwidth of 20 MHz and a signal to noise ratio of 30 dB.

1. What data rate does the sampling provide?
2. What is the maximum data rate of the channel?

B = 20 MHz = 20 \* 106 Hz

SNR = 30 dB

ips (information per sample) = 2b

L = ips2= 4

1. data rate = B \* ips = 20 \* 106 Hz \* 2b = 40 Mbps

**Answer:** The sampling provides the data rate of 40 Mbps.

SNR = 10 \* log10(S/N)

log10(S/N) = SNR / 10

S/N = (SNR / 10)10 = (30 dB / 10)10 = 59 049 dB

1. mdr NY (max data rate Nyquist) = 2 \* B \* log2L = 2 \* 20 \* 106 Hz \* log24 = 80 Mbps

Mdr SH (max data rate Shannon) = B \* log2(1+S/N) = 20 \* 106 Hz \* log2(59 050) =

317 Mbps

mdr REAL (real max data rate) <= min {mdr NY, mdr SH} = mdr NY = 80 Mbps

**Answer:** The maximum data rate of the channel is lower or equal to 80 Mbps.

# Problem 2:

Given the following bit sequences:

* A: 01101111
* B: 10000111
* FLAG: 01111110
* ESC: 11100000

show the transmitted bit sequence for data = FLAG A B ESC when using:

1. byte count,
2. flag bytes with byte stuffing,
3. flag bytes with bit stuffing.

| data | = 4 B

| data BCount | = | data | + 1B = 5B

1. data BCount = | data BCount | + data =

00000101 01111110 01101111 10000111 11100000

1. data BStuffing = FLAG ESC FLAG A B ESC ESC FLAG =

01111110 11100000 01111110 01101111 10000111 11100000 11100000 01111110

1. ­data bStuffing = FLAG FLAG A B ESC FLAG + [0 after every 5 successive 1s] =

01111110 011111010 01101111 100000111 110100000 01111110